Westinghouse



# TYPE CM PHASE BALANCE CURRENT RELAY

## INSTRUCTIONS

## CAUTION

Before putting relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

## APPLICATION

The type CM relay is an induction type relay designed to protect polyphase electrical machinery against phase unbalance or phase failure.

## CONSTRUCTION AND OPERATION

The type CM relay consists of four single phase current elements, a contactor switch, and an operation indicator connected as shown in figure 1.

### Current Elements

These elements are mounted in pairs, each pair of electromagnets operating on a single disc. The disc is damped by two permanent magnets on either side and between the electromagnets. Each disc carries its own set of contacts with the two sets being connected in parallel in order that either disc may close the trip circuit.

The electromagnet pair are mounted face to face on opposite sides of the disc, and so connected that the electrical torque of one element opposes that of the other, thus producing balanced mechanical torque on the disc when the magnitudes of the currents through each of the two elements are equal. One of the electromagnets on the lower disc is connected in series with one of the electromagnets on the upper disc. Thus phase A current may balance phase B current on the upper disc, and phase B current balance phase C current on the lower disc. Consequently with balanced system conditions, no mechanical torque is produced on the two discs, but with unbalanced conditions or an open phase the balance on the disc is upset and one or two sets of contacts close.

Operating current is fed into a tapped coil on the lower pole of each electromagnet. On this same pole a secondary coil is wound and connected to the coils on the two upper poles through a small two winding transformer known as the torque compensator. Current induced in this secondary coil, flows thru the torque compensator to the upper pole coils and thus produces torque in the disc by the reaction between the fluxes of the upper and lower poles. Thus the operation of the relay is independent of the relative instantaneous direction of current in the three phases. The torque compensator acts to allow adjustment of the electromagnets so that the required operating curve is secured. It also acts to slow down the disc movement so that no gearing is required.

The contacts are single pole double throw. The moving contact is fastened directly to the disc shaft and the electrical connection is made thru a spiral spring fastened to the moving contact arm and frame assembly. The two stationary contacts on either side of the moving contact are 180° apart and are not adjustable. They are connected together electrically.

### Contactor Switch

The d-c. contactor switch in the relay is a small solenoid type switch. A cylindrical plunger with a silver disc mounted on its lower end moves in the core of the solenoid. As the plunger travels upward, the disc bridges three silver stationary contacts. The coil is in series with the main contacts of the relay and with the trip coil of the breaker. When the relay contacts close, the coil becomes energized and closes the switch contacts. This shunts the main relay contacts, thereby relieving them of the duty of carrying tripping current. These contacts remain closed until the trip circuit is opened by the auxiliary switch on the breaker. The contactor switch is equipped with a third point which is connected to a terminal on the relay to operate a bell alarm.

### Operation Indicator

The operation indicator is a small solenoid coil connected in the grip ccircuit. When the coil is energized, a spring-restrained armature releases the white target which falls by gravity to indicate completion of the trip circuit. The indicator is reset from outside of the case by a push rod in the cover stud.

## CHARACTERISTICS

The type CM relay is provided with four sets of 2, 4, and 6 ampere taps. The tap value is the minimum pick-up current of each electro-magnet with the other paired electromagnet de-energized.

The characteristic curves of the relay are shown in figures 2 and 3.

## INSTALLATION AND SETTING

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the two mounting studs. Either of these studs may be utilized for grounding the relay base. The electrical connections may be

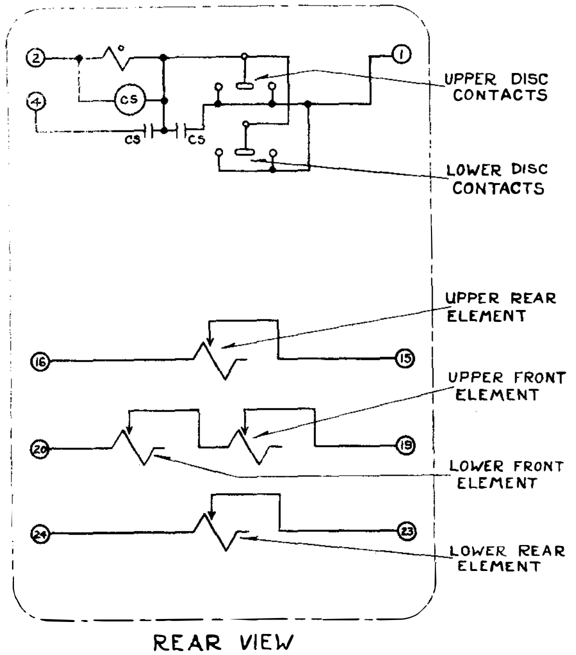


Figure 1
Schematic Internal Connections of the Type CM Relay.

made direct to the terminals by means of screws for steel panel mounting or to terminal studs furnished with the relay for ebony-asbestos or slate panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the studs and then turning the proper nut with a wrench.

Typical external connections are shown in figure 4.

The relay is shipped with the operation indicator and the contactor switch coils in parallel. This circuit has a resistance of approximately 0.25 ohm and is suitable for all trip circuits above 2.25 amperes d-c. If the trip current is less than 2.25 amperes there is no need for the contactor switch and it should be disconnected. To disconnect the coil, remove the short lead to the coil on the front stationary contact of the contactor switch. This lead should be fastened (dead ended) under the small filister head screw located in the Micarta base. The operation indicator will operate for trip circuits above 0.2 amperes d-c. The resistance of its coil is approximately 2.8 ohms.

The relays are set to operation on an unbalance as shown in the operating curve of figure 2. For example, if the full load secondary current on a motor is 4 amperes, then using the 2 ampere taps, the relay will operate if one phase current supplying the front electromagnet drops to 3.5 amperes, representing an unbalance of 12.5%. It will be noted that the relay is most sensitive for currents between 150 to 350% of tap value.

After selecting the tap, the same tap setting should be made on all four elements. Be sure that the tap screw is turned up tight so as to make a good contact; for the operating current passes through it. Since each element is connected directly in the current transformer circuit the latter should be short circuited before changing the connector screw if the relay

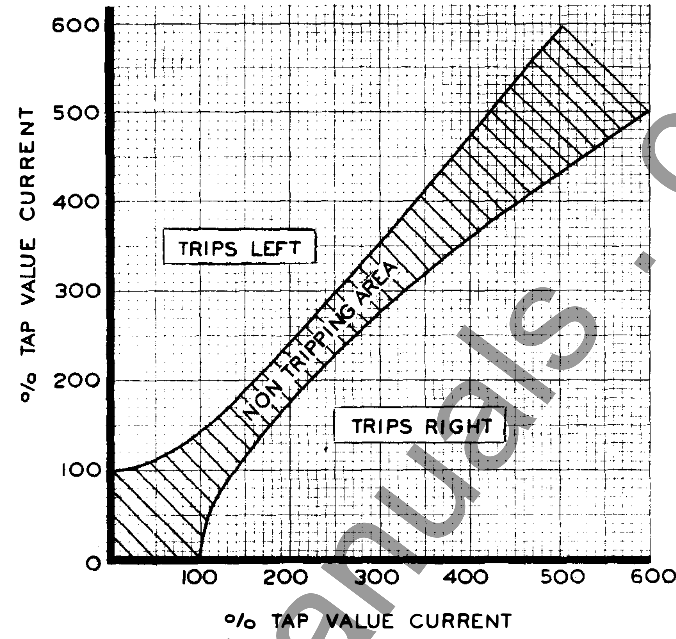


Figure 2
Typical 50 and 60 Cycle Operating Curve of the Type CM Relay.

is in service. This can be done by inserting the extra connector screw located on the permanent magnet plate in the new tap before removing the old screw from its original setting.

## ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments or regular maintenance periods, the instructions below should be followed.

All contacts should be periodically cleaned with a fine file. S#1002110 file is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

### Current Element

Check the rotation produced by the electromagnets. A front electromagnet alone should rotate the disc to the left; and a rear electromagnet, to the right.

Connect the relay per test diagram of figure 5A. With the load resistance adjusted for 20 amperes a-c and the four tap screws in the 2 ampere taps, check to see that neither upper or lower disc rotates. The rotation can be stopped by rotating the torque compensators slightly about their pivot points on the front plate. Make sure that the torque compensators have been screwed down tightly after the adjustments are completed.

The adjustment for minimum trip should be such that the pick-up values for the rear and front electromagnets are the same. Also the moving contact should be approximately midway between the two stationary contacts with the relay de-energized. These adjustments will be approximately correct when the balance test outlined above have been made and final adjustments usually can be made by slightly bending the stationary contacts. Minimum trip should be checked for all taps.

The typical operating curve of figure 2 can be checked with the relay connected as shown in figure 5B. This checks the upper element. To check the lower element move the leads from terminals 16 and 15 to 24 and 23 respectively. It should be remembered that figure 2 represents a typical curve and individual relays may vary somewhat from these values.

## RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.

## ENERGY REQUIREMENTS

The burden each electromagnet is as follows. This represents the burdens on the current transformers connected to terminals 15 and 16 or 23 and 24, see figure 1. The burden on the current transformers connected to terminals 19 and 20 is 2 times these values.

At 5 Amperes, 60 Cycles

| Tap | Watts | Vars. | Volt Amperes | P.F. Angle |
|---|---|---|---|---|
| 2 | 6.4 | 30.0 | 30.75 | 78° Lag |
| 4 | 2.37 | 8.27 | 8.6 | 74° Lag |
| 6 | 1.37 | 3.76 | 4.0 | 70° Lag |

At 5 Amperes, 50 Cycles

| Tap | Watts | Vars. | Volt Amperes | P.F. Angle |
|---|---|---|---|---|
| 2 | 5.63 | 24.4 | 25.0 | 77° Lag |
| 4 | 1.54 | 6.68 | 6.85 | 71° Lag |
| 6 | 1.42 | 3.04 | 3.35 | 65° Lag |

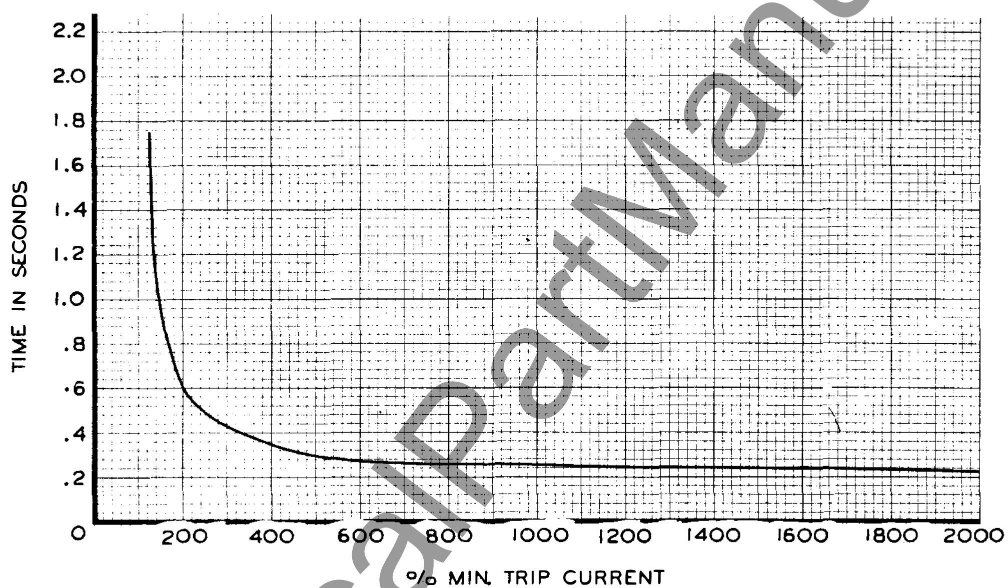


Figure 3
Typical 60 Cycle Time Curve With Only One Element Energized at a Time.

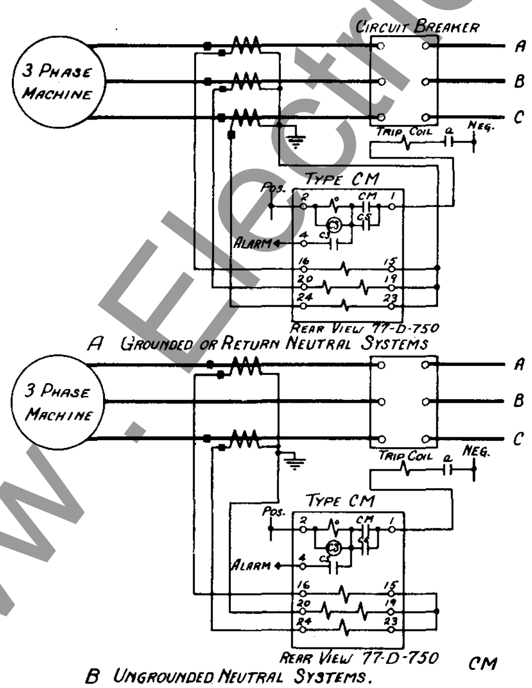


Figure 4
External Connections of the Type CM Relay

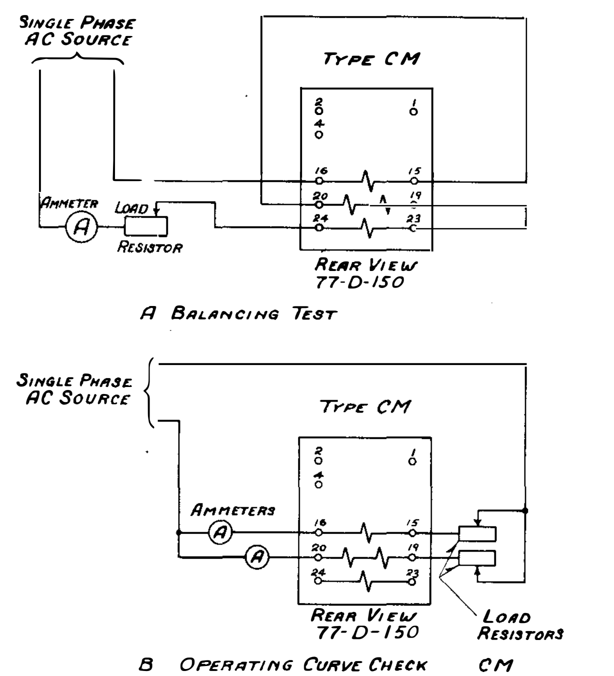


Figure 5
Diagram of Test Connections for the Type CM Relay.

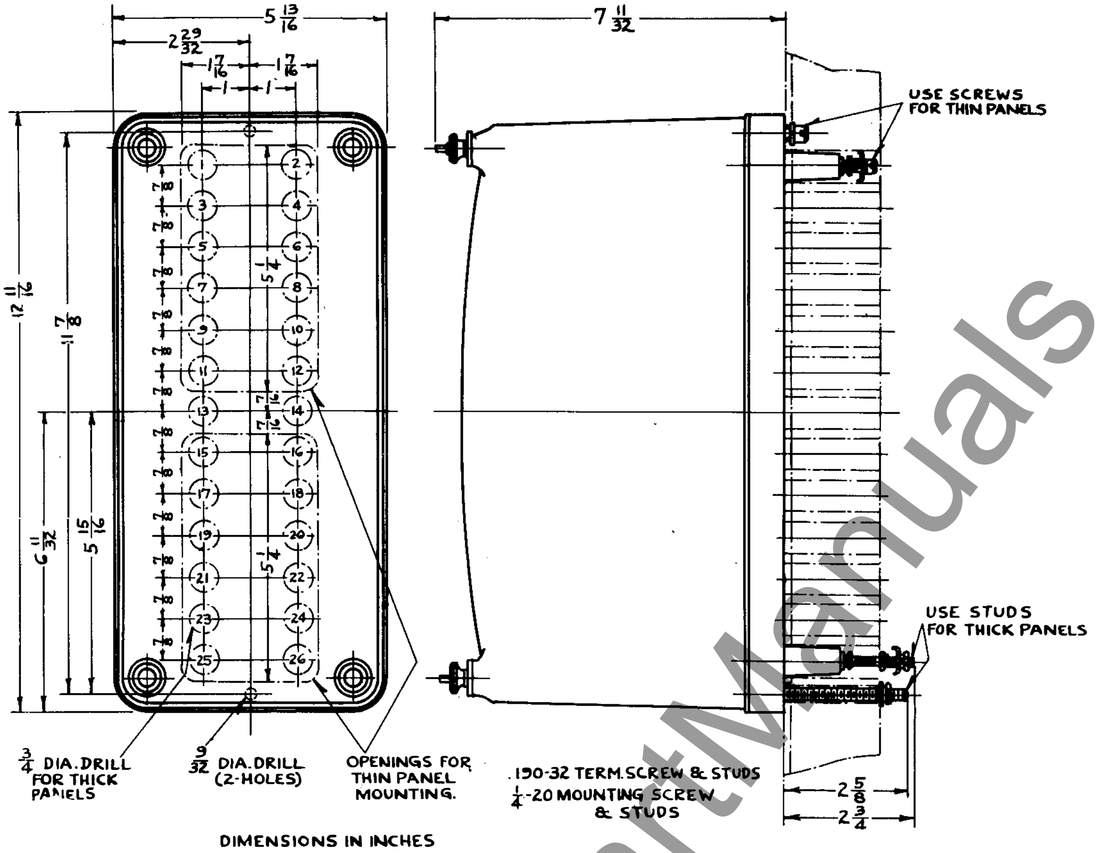


Figure 6
Outline and Drilling Plan for the Standard Projection Type Case (See figure 1 for the Terminals Supplied.)

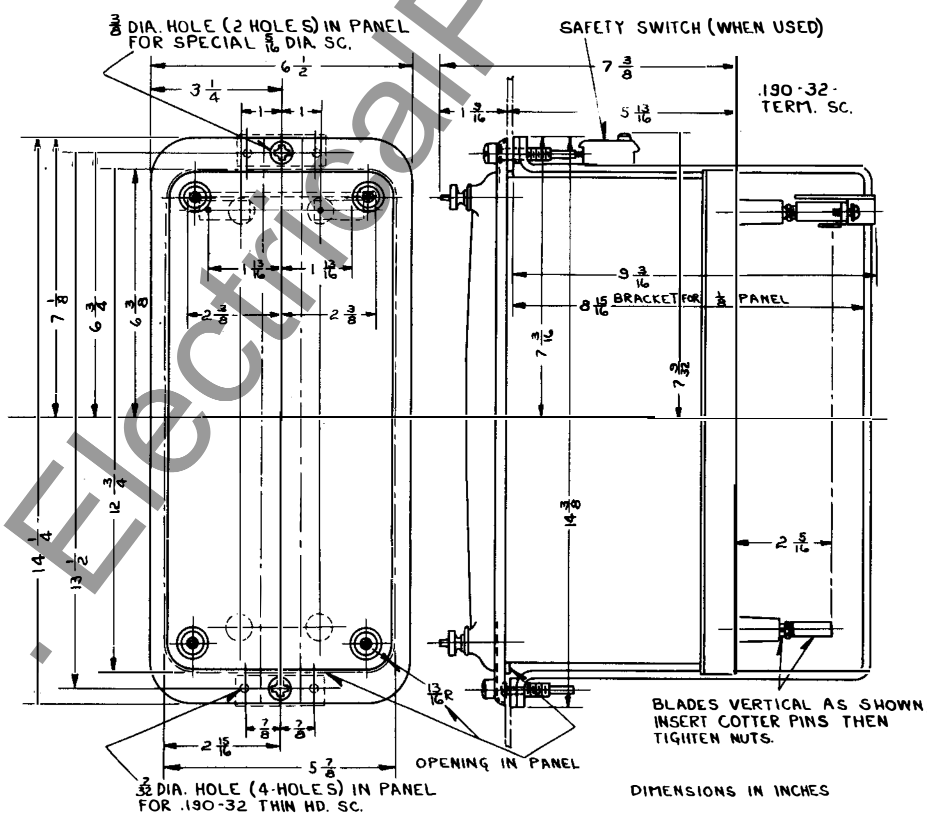


Figure 7
Outline and Drilling Plan for the Standard Plug-in Semi-Flush Type Case for 1/8" Panel Mounting.